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NEW SINGLE HORN SYSTEM

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The upstream horn of the double horn system failed while being power tested at very low current level with a transformer system[1] a few weeks ago. Although the direct cause of the failure was found to be due to insufficient water cooling, later tests with a new single horn strongly indicate that the double horn system could not be run for a multi-millisecond pulse without major extensive modifications that would require prohibitingly high radiation exposure to personnel. Furthermore, the double horn system requires a high operating voltage at the transformer primary, above 10 kV.

The schematic drawing of the new single horn system[2] is shown in Figure 1. The inner conductor of 2.4 meters in length was built from two pieces of about 1.2 meters each. The horn was power tested for about 3500 pulses of 8 msec base width and 120 kA peak current. Most of bolted joints with small contact areas were severely damaged due to pitting. Some bolts were loosened from mechanical vibrations. These difficulties had never been experienced previously when the horns were operated for shorter pulses without a transformer. Extensive modifications to the striplines, horn and yoke have been made in order to reduce the number of bolt joints with small contact areas and to increase mechanical strength. The two pieces of the inner conductor have been welded together and a tank size flange was welded to downstream end. All the aluminum joint surfaces have been copper plated first and then silver plated. The copper joint surfaces at the flexible bus have been silver plated.

Figures 2,3, and 4 show computed neutrino and antineutrino fluxes by the NUADA program[3] for the new single horn system. The incident proton energy is 400 GeV. Stefanski-White's parametrization[4] was used for particle production. Computed neutrino fluxes for the double horn system and bare target are also shown in Figure 2. Relative neutrino event rates for the single horn system are given in Table I for various currents. Also given are event rates for the double horn system and bare target for comparison.

The design current for the new horn is 140 kA and the voltage of the

transformer primary side is slightly above 6 kV. We are designing a horn inner conductor which is optimized for low current and low voltage at the transformer primary side.[2] This will allow us to improve operational reliabilities of the whole horn system which includes the power supply, transmission line, transformer, and horn.

We are very grateful to the members of the CERN HORN GROUP and Dr. F.Nezrick for informing us very useful techniques for pitting problems.

REFERENCES

1. F. A. Nezrick, Can the Horn System Be Modified to Accomodate a 1 msec Spill ?, TM-536,December 1974, and R. C. Trendler, Results of Horn Transformer Studies to Provide a One Millisecond Horn Pulse, TM-666, June 1976.

2. S. Mori, Wide-Band Single Horn System, TM-663, May 1976 and TM-720, February 1977.

3. D. C. Cary and V. A. White, Fermilab Internal Report, NUADA, June, 1975. All the computations in this report were done by the NUADA program for the Fermilab CDC-6600 computer.

4. R. J. Stefanski and H. B. White, Jr., FN-292, 2060.000, 1976.

FIGURE CAPTIONS

Figure 1. Schematic drawing of the new single horn system.

Figure 2. Neutrino fluxes and wrong sign backgrounds for 400 GeV protons. No plug is used.

Figure 3. Antineutrino fluxes and wrong sign backgrounds for 400 GeV protons. No plug is used.

Figure 4. Antineutrino fluxes and wrong sign backgrounds for 400 GeV protons. An antineutrino plug of 2.8 cm in diameter and 2.4 m in length (aluminum) is used immediately downstream of the horn.

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RELATIVE NEUTRINO EVENT RATES OF NEW HORN AT 400 GEV

BEAM	NEUTRINO ENERGY RANGE (GEV)				
	0 TO 250	0 TO 50	50 TO 100	100 TO 150	150 TO 250
DOUBLE HORN	119	69	27	13	10
SINGLE HORN*					
160 KA	100	49	27	12	11
140 KA	100	51	27	12	11
120 KA	98	52	25	12	9.7
100 KA	94	50	24	11	8.7
80 KA	86	47	21	10	7.6
60 KA	78	44	19	8.7	6.6
BARE TARGET	38	17	11	5.3	4.4

* The design current for the Single Horn is 140 kA.

Table I.

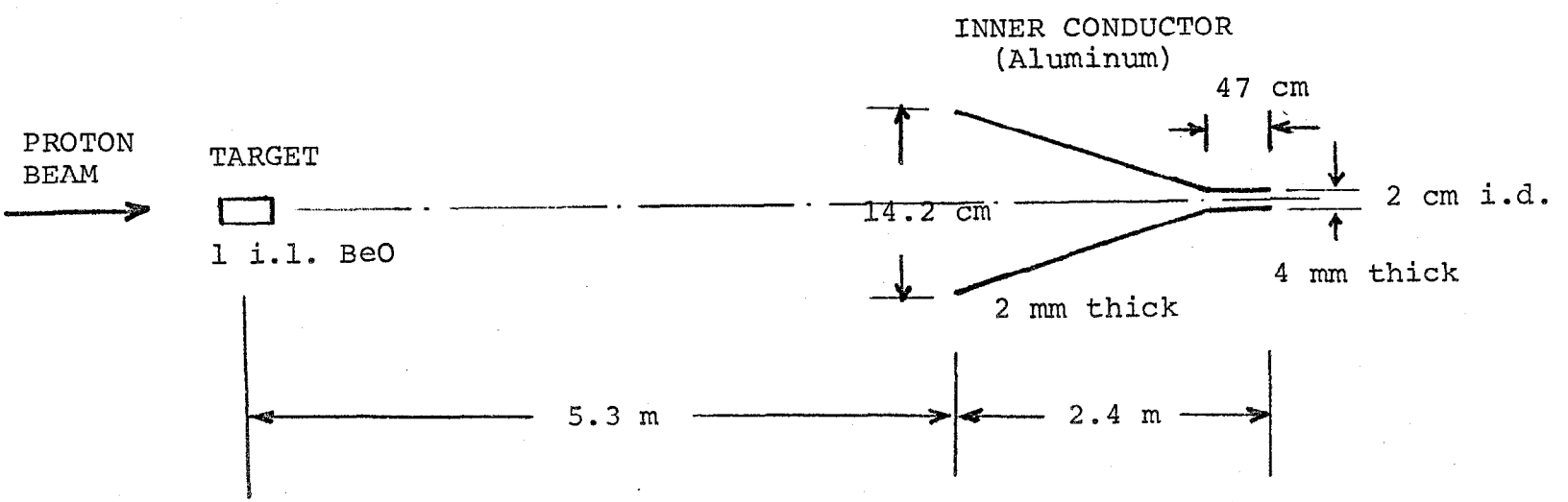

Figure 1. Schematic Drawing of the Single Horn System.

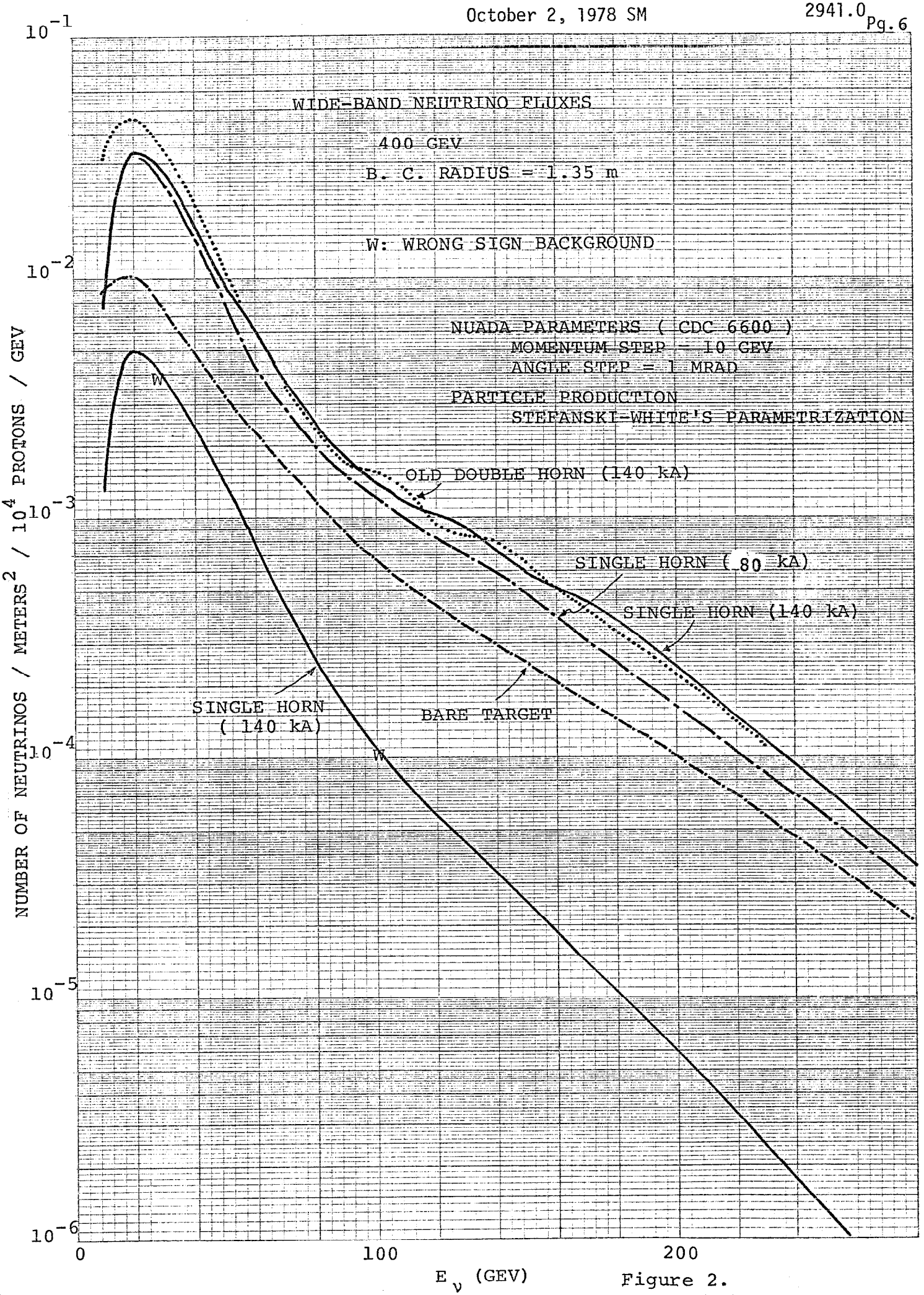
WIDE-BAND NEUTRINO FLUXES
400 GEV
B. C. RADIUS = 1.35 m
W: WRONG SIGN BACKGROUND
NUADA PARAMETERS (CDC 6600)
MOMENTUM STEP = 10 GEV
ANGLE STEP = 1 MRAD
PARTICLE PRODUCTION
STEFANSKI-WHITE'S PARAMETRIZATION
OLD DOUBLE HORN (140 kA)
SINGLE HORN (80 kA)
SINGLE HORN (140 kA)
BARE TARGET
SINGLE HORN
(140 kA)
W
W
NUMBER OF NEUTRINOS / METERS^2 / 10^4 PROTONS / GEV
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
0
100
200
E_ν (GEV)

Figure 2.

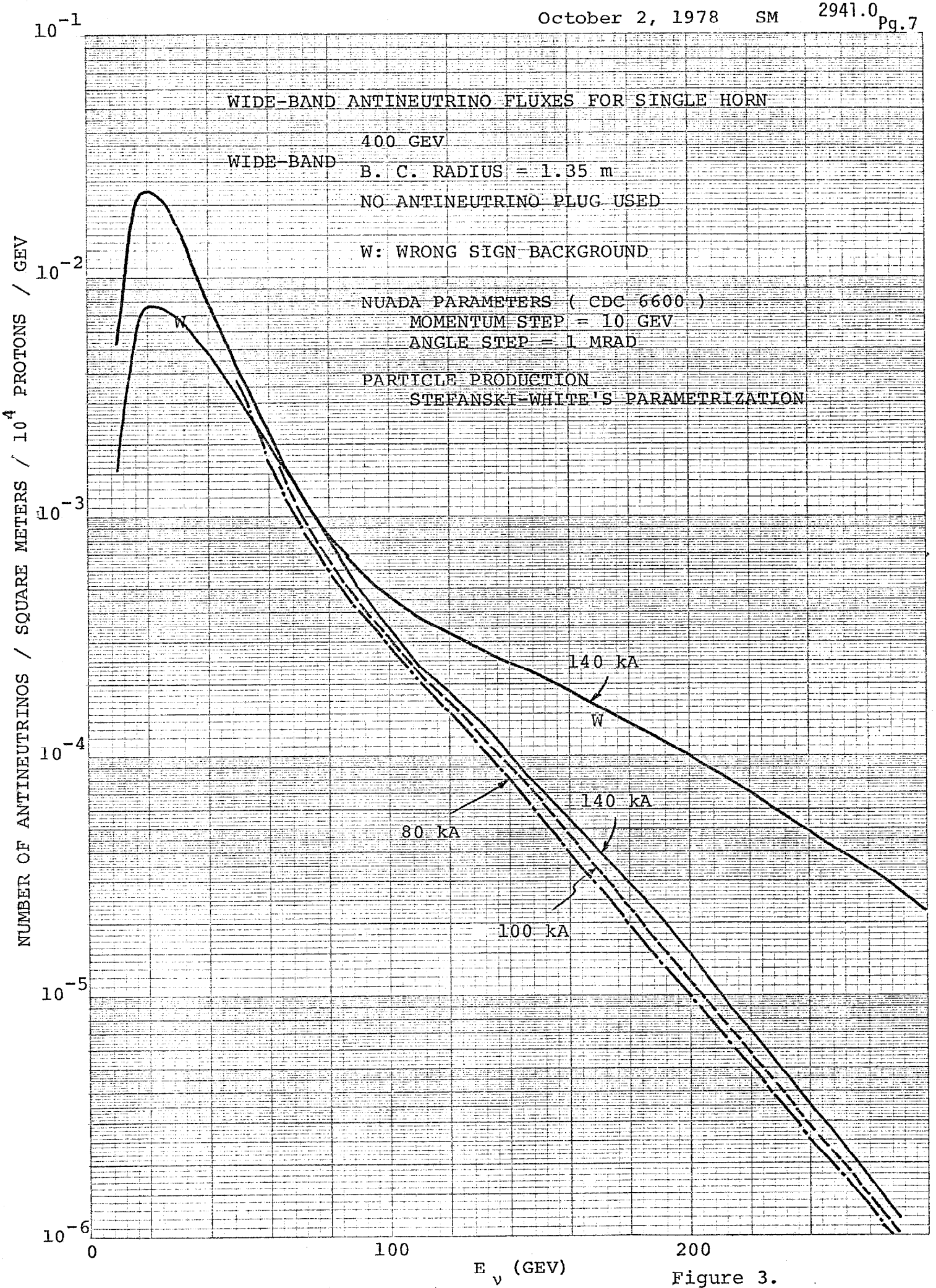
WIDE-BAND ANTINEUTRINO FLUXES FOR SINGLE HORN
400 GEV
WIDE-BAND
B. C. RADIUS = 1.35 m
NO ANTINEUTRINO PLUG USED
W: WRONG SIGN BACKGROUND
NUADA PARAMETERS (CDC 6600)
MOMENTUM STEP = 10 GEV
ANGLE STEP = 1 MRAD
PARTICLE PRODUCTION
STEFANSKI-WHITE'S PARAMETRIZATION
W
140 kA
W
140 kA
80 kA
100 kA
NUMBER OF ANTINEUTRINOS / SQUARE METERS / 10^4 PROTONS / GEV
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
0
100
200
E_ν (GEV)

Figure 3.

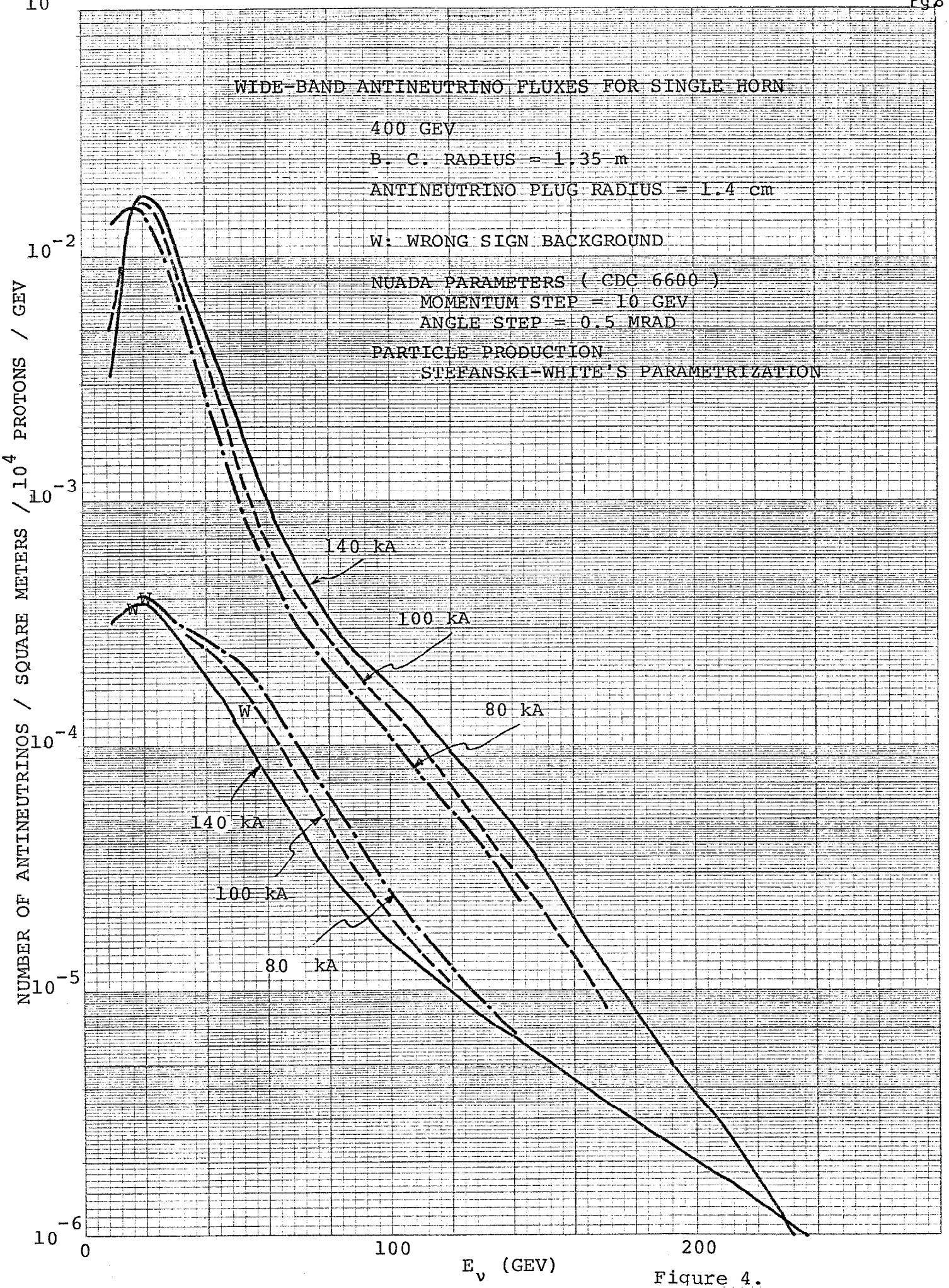
WIDE-BAND ANTINEUTRINO FLUXES FOR SINGLE HORN
400 GEV
B. C. RADIUS = 1.35 m
ANTINEUTRINO PLUG RADIUS = 1.4 cm
W: WRONG SIGN BACKGROUND
NUADA PARAMETERS (CDC 6600)
MOMENTUM STEP = 10 GEV
ANGLE STEP = 0.5 MRAD
PARTICLE PRODUCTION
STEFANSKI-WHITE'S PARAMETRIZATION
140 kA
100 kA
80 kA
W
W
140 kA
100 kA
80 kA
NUMBER OF ANTINEUTRINOS / SQUARE METERS / 10^4 PROTONS / GEV
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
0
100
200
E_ν (GEV)

Figure 4.